Outdoor Experiment Trial of Millimeter-Wave Coverage in 28 GHz and 39 GHz Bands

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SUMMARY. In Japan, toward further enhancement of the fifth generation (5G) mobile communication system, 39 GHz band is being considered as a candidate of additional millimeter-wave bands to be allocated. Therefore, this paper shows 39 GHz-band coverage performance measured by an outdoor experimental trial compared with 28 GHz band.

key words: *5G, 39 GHz, Millimeter-wave, Outdoor, Coverage.*

1. Introduction

5G commercial services launched all over the world, and in Japan, the initial 5G commercial service started in March 2020 [1]. Moreover, as a candidate of new frequency bands to be allocated to 5G, 39 GHz band will be examined in addition to the existing 28 GHz band [2]. However, the 39 GHz-band transmission performance has not been sufficiently investigated. Therefore, we measured outdoor transmission performances by using 28 GHz and 39 GHz-band experimental equipment, and in this paper, the potential of the 39 GHz band is clarified by comparing them.

2. Experimental System and Major Specifications

In this experimental trial, Base Station (BS) and Mobile Station (MS) made by Ericsson as the 5G Testbed were used, and Table 1 shows major specifications of the experimental equipment. EIRP (Equivalent Isotropically Radiated Power) of the 39 GHz BS is 6 dB larger than that of the 28 GHz BS. The maximum data rates of both frequency bands in this experimental trial are 440 Mbps in downlink (DL) two-MIMO-stream transmission. The distance from the BS to the line-of-sight (LOS) area was 526 m.

3. Experimental Results

Figure 1 shows a top view of the BS and MS deployment and a measurement course. The BS antenna was installed on the roof of the building which is approximately 29 m tall, and DL throughput was measured when a vehicle equipped with the MS antenna was traveling at 20 km/h on a straight road in front of the building.

Figure 2 shows measured DL throughput performances. Because the measured course was a uphill, the MS antenna height matched with the height of the BS antenna, and the down-tilt angle of the BS antennas was 10 degrees, it is considered that the MS antenna deviated from the half-value angle and the connections were interrupted around 450 m in both bands. Because of different position and structure of the BS antennas, the 39 GHz BS antenna was shielded more strongly by traffic lights and street trees compared to the 28 GHz BS antenna, which probably caused fluctuations of the DL throughput. The DL throughput achieves approximately 380 Mbps in both frequency bands, and the transmission performance of the 28 GHz band was almost the same as that of the 39 GHz band. Although the EIRP of the 39 GHz BS is 6 dB larger than that of the 28 GHz BS, the free-space pathloss is also approximately 3 dB higher. Therefore, there was no difference in the maximum DL throughput.

Table 1 Experimental system specifications.

Key parameters	39G BS	39G MS	28G BS	28G MS
Center frequency	39.7 GHz		27.6 GHz	
Subcarrier spacing	120 kHz			
Bandwidth	100 MHz			
Duplex	TDD (DL:UL = 4:1)			
Transmission scheme	OFDMA			
No. of MIMO streams	DL / UL: Up to 4			
No. of antenna elements	384	8	256	8
Antenna gain	25 dBi	5 dBi	24 dBi	5 dBi
Transmission power	29 dBm	18 dBm	24 dBm	12 dBm
EIRP	54 dBm	23 dBm	48 dBm	17 dBm

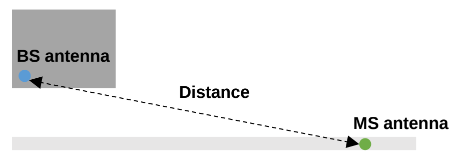

Fig. 1 Top view.

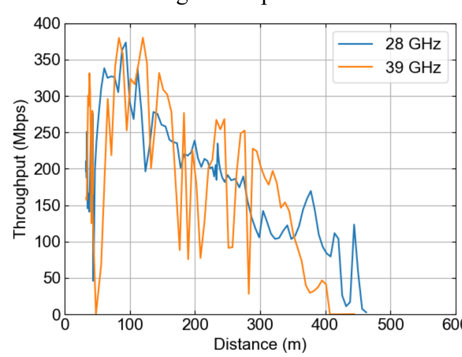

Fig. 2 DL Throughput.

4. Conclusion

The measured DL throughput of the 39 GHz band is almost the same as that of the 28 GHz band, showing no significant difference in throughput, and it is confirmed that the 39 GHz band can be utilized for service provision as well as the 28 GHz band.

References

[1] Ministry of Internal Affairs and Communications, "2020 White Paper Information and Communications in Japan," December 2020.

[2] Ministry of Internal Affairs and Communications, "Frequency Reorganization Action Plan (FY 2021 version)," November 2021.

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